GE Power & Water

Water & Process Treatment

Potash Evaporator and Crystallizer

Nico Siegenthaler

Luca Mor



Today's Agenda

- Technology Overview
- Project-Balance



Two ways of evaporation

- Steam / Waste heat

  Preferred when there is excess on heat or steam at the site

- Mechanical Vapor Recompression (MRV)

  Used if electricitiy is preferred



Principle of MVR-evaporation

MRV → Mechanical Vapor Recompression

Vapour to fan

T= 60°C
p=199 mbar(a)

Fan

6-10 kWh/m³

Δ T= 2.3°C
Δ p= 22 mbar(a)

Effluent

Vapour
from fan

Heat transfer
surface

T= 62,3°C
p= 221 mbar(a)

Condensate

Vacuum system as example only… our systems are mostly atmospheric pressure



MVR Evaporation

COMPRESSOR

Compressed Vapour

DT

Vapour

Steam consumption = 0

Cooling water cons. = 0

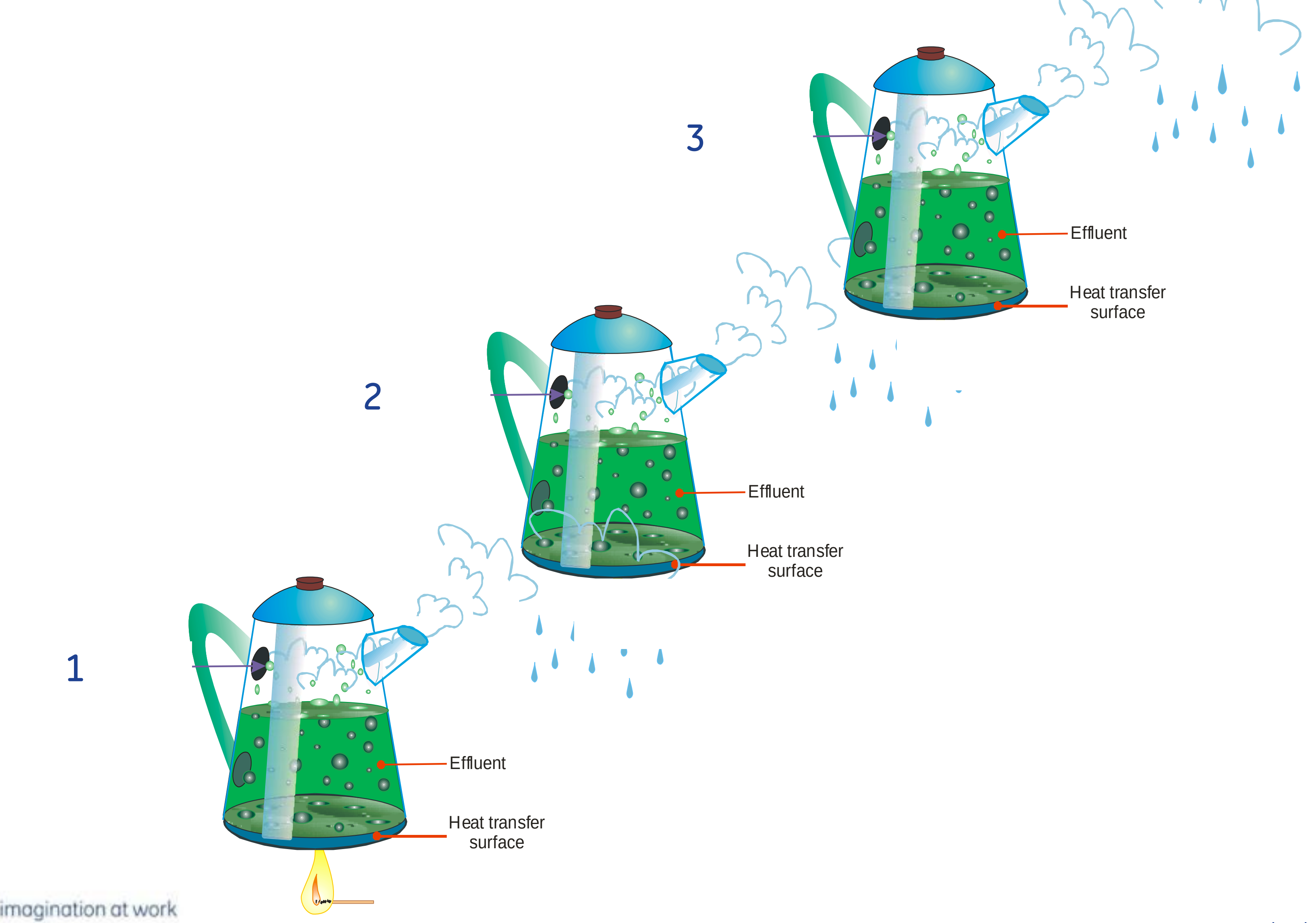
Feed (pre-heated)

Concentrate

Condensate



Multi-effect evaporation



4-Effect Evaporation

Specific Steam Consumption = 0.28

Cooling

CONDENSER

Water

Vapour

Feed

Vapour

Vapour

Vapour

Steam
Vapour

Waste Heat

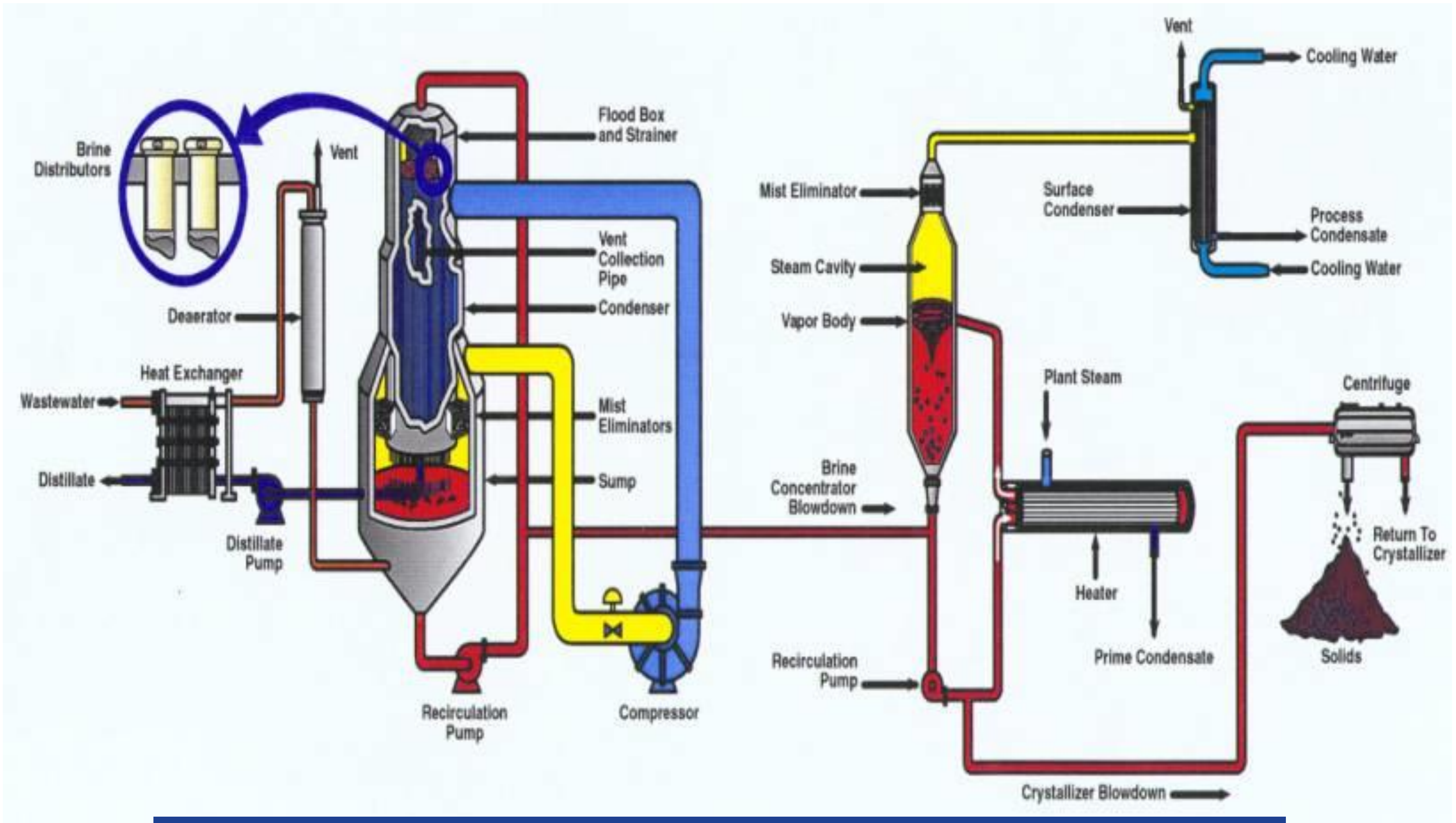
Concentrate

Primary Condensate

Condensate



Evaporator and Crystallizer Technology

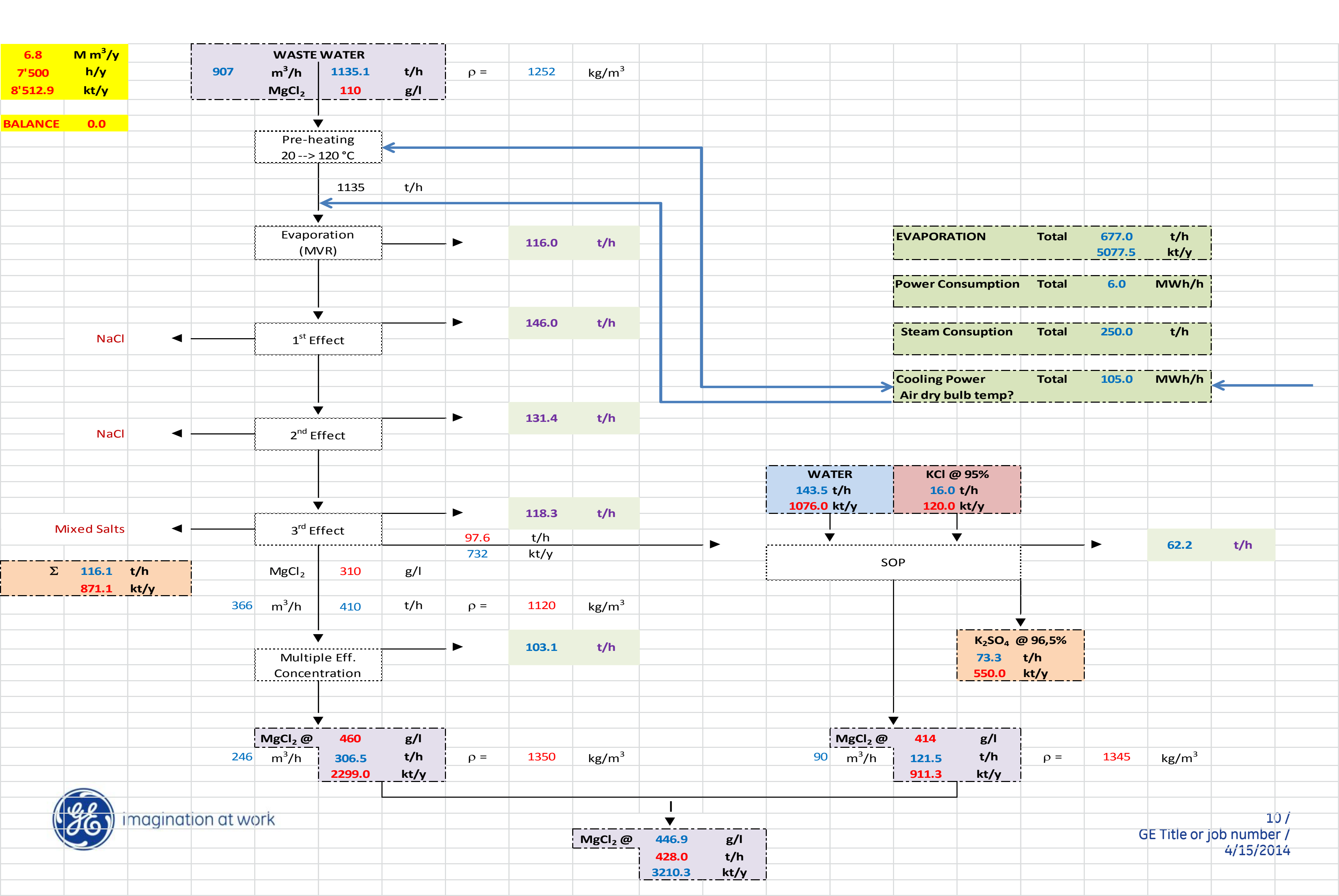


Result is achieved by the combination of evaporation & crystallization

Project-Balance



Overall Massbalance



1. Step MVR

VAPOR COMPRESSOR
42-K2-001
QTY : 1

VFD

VAPOR DUCT
SUCTION
42-L1-001
QTY : 1

SEAL LEG

CIRCULATION DUCT
DELIVERY
42-L1-013
QTY : 1

VAPOR DUCT
DELIVERY
42-L1-002
QTY : 1

HEAT EXCHANGER
42-H3-001
QTY : 1

42-L1-011
QTY : 1

CIRCULATION DUCT
SUCTION
42-L1-012
QTY : 1

CIRCULATION PUMP
42-P1-101
QTY : 1

433
455
434
432
451
431



2. Step Triple effect Evaporation/Crystallization

1st EFFECT VAPOR HEAD 43–D5–101 QTY : 1

2nd EFFECT VAPOR HEAD 43–D5–201 QTY : 1

3rd EFFECT VAPOR HEAD 43–D5–301 QTY : 1

1st EFFECT FC H.E. 43–H3–101 QTY : 1

2nd EFFECT FC H.E. 43–H3–201 QTY : 1

3rd EFFECT FC H.E. 43–H3–301 QTY : 1

1st EFFECT CIRC. PUMP 43–P1–101 QTY : 1

2nd EFFECT CIRC. PUMP 43–P1–201 QTY : 1

3rd EFFECT CIRC. PUMP 43–P1–301 QTY : 1

1st EFFECT TRANSF. PUMP 43–P1–102

2nd EFFECT TRANSF. PUMP 43–P1–202 QTY : 1

3rd EFFECT TRANSF. PUMP 43–P1–302 QTY : 1

432



3. Step double/triple effect concentration

1st EFFECT
VAPOR HEAD
43–D5–101
QTY : 1

2nd EFFECT
VAPOR HEAD
43–D5–201
QTY : 1

3rd EFFECT
VAPOR HEAD
43–D5–301
QTY : 1

1st EFFECT
FC H.E.
43–H3–101
QTY : 1

2nd EFFECT
FC H.E.
43–H3–201
QTY : 1

3rd EFFECT
FC H.E.
43–H3–301
QTY : 1

1st EFFECT
CIRC. PUMP
43–P1–101
QTY : 1

2nd EFFECT
CIRC. PUMP
43–P1–201
QTY : 1

3rd EFFECT
CIRC. PUMP
43–P1–301
QTY : 1

1st EFFECT
TRANSF. PUMP
43–P1–102

2nd EFFECT
TRANSF. PUMP
43–P1–202
QTY : 1

3rd EFFECT
TRANSF. PUMP
43–P1–302
QTY : 1

432

4. Step K_2SO_4 Crystallization

VACUUM
VAPOUR
VAPOUR
VAPOUR
E 504
G 521
DU 501
DU 502
DU 503
E 501
E 502
E 503
PROCESS CONDENSATE
PC 502
LANGBEINITE + NaCl
BRINE E
BRINE E
PROCESS CONDENSATE
(TEST ON THE PILOT UNIT)
STEAM CONDENSATE
BRINE E
BRINE C
BRINE M
BRINE L
LANGBEINITE + NaCl SLURRY
G 501
G 504
G 502
G 505
G 503
G 506
G 511
DD 501
G 507

5. Pre-Step only Variant B

COOLING WATER
COOLING WATER
VAPOUR
E 601
J 601
VAPOUR
E 603
DU 601
80°C
FLASH COOLING
E 602
DU 602
45°C
FLASH COOLING
CARNALLITE + KCl + NaCl SLURRY
BRINE E
DD 601
G 601
G 603
G 602
G 604
G 605



Condensate cooling

136.8 m³/h

4 Nc

pH	8.98
m-alk	590
Ca	540
Mg	240
Cond.	3036
SiO_2	33.2
Cl	42
SO_4	936.0
LSI	2.71

182.4 m^3/h

2000 m^3

9500 m^3/h

45.6 m^3/h



Consumption

Power Consumption	Total	6.0	MWh/h
Steam Consuption	Total	250.0	t/h
Cooling Power Air dry bulb temp?	Total	105.0	MWh/h



Equipment Price

Design Basis	Budgetary Price (+/- 30%)
• Evaporation Pkg.	~95% of price
• Crystallization Pkg.	~5% of price
Total System Price	**€ 110,000,000**



Total Turnkey est.

	cost % of equipment	EQUIPMENT TOTAL	100'000'000
Miscellaneous Process Equipment (Piping, etc.)	5%		5'000'000
Field I&C and Control System	5%		5'000'000
Spare parts	3%		3'000'000
Civil works (foundations)	5%		5'000'000
Steel structure	10%		10'000'000
Installation	30%		30'000'000
TOTAL			**158'000'000**



THANK YOU!




imagination at work